CLAIMS

What Is Claimed Is:

1. A method of simulating a circuit, the method comprising:

defining a differential-algebraic equation of the circuit;

defining a simulation time interval corresponding to the differential-algebraic equation;

dividing the simulation time interval into time intervals, wherein the time intervals have corresponding polynomials for each time interval, wherein each polynomial is a portion of an approximation to a desired solution of the differential-algebraic equation; and

applying a collocation method to discretize the differential-algebraic equation.

2. The method of Claim 1, wherein the simulation time interval has collocation points, and wherein the interpolating polynomial has a degree of *M*.

3. The method of Claim 2, wherein located at each collocation point t_j is a value of $u(t_j)$, respectively, to be interpolated with polynomials.

4. The method of Claim 2, wherein the approximation to the desired solution of the differential-algebraic equations is $I_M u(t) = \sum_{k=0}^{M} \tilde{u}_k T_k(t)$, wherein M is the highest degree of the interpolating polynomials.

5. The method of Claim 4, wherein a derivative of the approximation is $(I_M u)'(t) = \sum_{k=0}^{M} \tilde{u}'_k T_k(t)$.

6. The method of Claim 5, wherein each coefficient $\tilde{u}'_k$ is computed from $\tilde{u}_k$.

7. The method of Claim 1, wherein the circuit is a radio frequency (RF) circuit.

8. The method of Claim 1, wherein the step of applying a collocation method comprises applying Chebyshev

collocation to discretize the set of differential-algebraic equation.

9. A method of solving a set of differential-algebraic equations arising in a circuit simulation, the method comprising:

applying a collocation method to each differential-algebraic equation to discretize the set of differential-algebraic equations; and

forming a solution to the set of differential-algebraic equations based on the discretized differential-algebraic equation.

10. The method of Claim 9, wherein the set of differential-algebraic equations comprises at least one of: a set of initial-value differential-algebraic equations and a set of boundary-value differential-algebraic equations.

11. The method of Claim 9, wherein the circuit simulation is a radio frequency (RF) circuit simulation.

12. The method of Claim 9, wherein the step of applying a collocation method comprises applying Chebyshev collocation to each differential-algebraic equation to discretize the set of differential-algebraic equations.

13. The method of Claim 9, wherein the set of differential-algebraic equations comprises a set of boundary-value differential-algebraic equations, and wherein the boundary-value differential-algebraic equations are discretized in intervals, and wherein neighboring intervals share a boundary.

14. The method of Claim 13, further comprising enforcing continuity of the solution at the boundary of neighboring intervals.

15. The method of Claim 9, wherein the set of differential-algebraic equations comprises a set of boundary-value differential-algebraic equations, and wherein the boundary-value differential-algebraic equations include a first and a last interval.

16. The method of Claim 15, further comprising enforcing a boundary condition at a boundary of the first and the last interval.

17. The method of Claim 13, further comprising:

solving the set of differential-algebraic equations using a Newton-Raphson iterative method; and

in each Newton-Raphson step of the Newton-Raphson iterative method, solving a linear Jacobian system using a linear iterative method.

18. The method of Claim 13, further comprising determining an order of accuracy desired in each interval.

19. The method of Claim 18, wherein the solution in a particular interval is smooth, and wherein the step of determining the order of accuracy desired in each interval comprises determining whether to increase the order of accuracy of the particular interval.

20. The method of Claim 18, wherein the solution in a particular interval is not smooth, and wherein the step

of determining the order of accuracy desired in each interval comprises splitting the particular interval into at least two subintervals.

21. The method of Claim 17, further comprising separately approximating for each interval a local preconditioner.

22. The method of Claim 21, wherein the local preconditioner comprises at least one of:

a capacitance matrix; and

a conductance matrix.

23. A computer-readable medium carrying one or more sequences of one or more instructions for solving a set of differential-algebraic equations arising in a circuit simulation, the one or more sequences of one or more instructions including instructions which, when executed by one or more processors, cause the one or more processors to perform the steps of:

applying a collocation method to each differential-algebraic equation to discretize the set of differential-algebraic equations; and

forming a solution to the set of differential-algebraic equations based on the discretized differential-algebraic equation.

24. The computer-readable medium of Claim 23, wherein the set of differential-algebraic equations comprises at least one of: a set of initial-value differential-algebraic equations and a set of boundary-value differential-algebraic equations.

25. The computer-readable medium of Claim 23, wherein the circuit simulation is a radio frequency (RF) circuit simulation.

26. The computer-readable medium of Claim 23, wherein the step of applying a collocation method further causes the processor to carry out the step applying Chebyshev collocation to each differential-algebraic equation to discretize the set of differential-algebraic equations.

27. The computer-readable medium of Claim 23, wherein the set of differential-algebraic equations comprises a set of boundary-value differential-algebraic equations, and

wherein the boundary-value differential-algebraic equations are discretized in intervals, and wherein neighboring intervals share a boundary.

28. The computer-readable medium of Claim 27, wherein the instructions further cause the processor to carry out the step of enforcing continuity of the solution at the boundary of neighboring intervals.

29. The computer-readable medium of Claim 23, wherein the set of differential-algebraic equations comprises a set of boundary-value differential-algebraic equations, and wherein the boundary-value differential-algebraic equations include a first and a last interval.

30. The computer-readable medium of Claim 29, wherein the instructions further cause the processor to carry out the step of enforcing a boundary condition at a boundary of the first and the last interval.

31. The computer-readable medium of Claim 27, wherein the instructions further cause the processor to carry out the steps of:

solving the set of differential-algebraic equations using a Newton-Raphson iterative method; and

in each Newton-Raphson step of the Newton-Raphson iterative method, solving a linear Jacobian system using a linear iterative method.

32. The computer-readable medium of Claim 27, wherein the instructions further cause the processor to carry out the step of determining an order of accuracy desired in each interval.

33. The computer-readable medium of Claim 32, wherein the solution in a particular interval is smooth, and wherein the step of determining the order of accuracy desired in each interval further causes the processor to carry out the step of determining whether to increase order of the particular interval.

34. The computer-readable medium of Claim 32, wherein the solution in a particular interval is not smooth, and wherein the step of determining the order of accuracy desired in each interval further causes the processor to

carry out the step of splitting the particular interval into at least two subintervals.

35. The computer-readable medium of Claim 31, wherein the instructions further cause the processor to carry out the step of separately approximating for each interval a local preconditioner.

36. The computer-readable medium of Claim 35, wherein the local preconditioner comprises at least one of:

a capacitance matrix; and

a conductance matrix.